



Technical Assistance Services for Communities

Lower Passaic River Diamond Alkali Superfund Site

TASC Response to Passaic River CAG Items of Interest July 2014

The Passaic River Community Advisory Group (CAG) asked the Technical Assistance Services for Communities (TASC) contractor to provide additional information to help CAG members with their understanding of the Proposed Plan for the lower eight miles of the Lower Passaic River, which is part of the Diamond Alkali Superfund site. This document contains the CAG's questions and TASC's responses.

The TASC contract provides EPA-funded technical support for communities living near hazardous waste sites. This support can include information assistance, community education and technical expertise. The contents of this document do not necessarily reflect the policies, actions or positions of EPA.

Resuspension

One line of discussion out there is the question of impacts from resuspension, and some have suggested dredging is more damaging than leaving sediments in place, though this is not the position of the CAG. It would be useful to have some nonbiased information to share with the CAG and community such as:

- Is there a useful way to describe the likely scope of the actual dredging itself and potential impacts from resuspension, etc. and any mitigation proposals by EPA?*

TASC Response:

Scope: The Proposed Plan estimates 4.3 million cubic yards of dredging, covering the entire 650 acres of the lower eight miles. This is about twice the amount of dredged material at the Hudson River site and four times the amount at the New Bedford Harbor site. Dredging at the New York New Jersey Harbor is similar in magnitude, although dredged material is primarily disposed of in the ocean (4-5 million cubic yards per year).¹

Impacts from resuspension: Resuspension increases turbidity (cloudiness due to particulate matter) in the water column, impacting organisms' survival in the water column and altering chemical concentrations. Resuspension causes fish and other organisms in the water to be exposed to higher concentrations of contaminants than usually present in the water column. Dredging temporarily destroys benthic habitat (bottom of the river) for ecological communities. According to EPA's Proposed Plan, natural recolonization of the benthic habitat following a dredging disturbance is usually fairly rapid, and can begin within days after perturbation. In some cases, full recovery to pre-disturbance species composition and abundance can occur within one to five years.

¹ EPA Region 2 Water Dredged Material Management Program: <http://www.epa.gov/region2/water/dredge/intro.htm#Management>

To mitigate resuspension impacts, EPA proposes:

- Reconstructing habitat impacted by dredging, including placing habitat recovery material and aquatic vegetation.
- Controlling sediment removal rates (through careful operation of the dredging equipment).
- Silt curtains and use of sheetpiling will be considered to help control resuspension of sediment. Section 3.5.1.1 of the Focused Feasibility Study (FFS) describes sediment dispersion control.
- Best management practices and state-of-the-art technology would be employed to minimize resuspension (Appendix F of the FFS).

- *This has been a common issue at all large-scale dredging sites. Is there information or materials that have been developed elsewhere that could be useful at Passaic?*

TASC Response:

The following resources from the U.S. Army Corps of Engineers provide information about the resuspension of sediment during dredging, potential releases of contaminants due to resuspension, residual contamination after dredging and associated risks:

- Sediment Resuspension: Defining the Issues. Doug Clarke, U.S. Army Corps of Engineers. http://www.aapa-ports.org/files/SeminarPresentations/07_OPIWKSHP_Clarke_Douglas.pdf.
- The Four Rs of Environmental Dredging: Resuspension, Release, Residual, and Risk. Bridges et al. U.S. Army Corps of Engineers (2008). http://el.erdc.usace.army.mil/elpubs/pdf/trel08_-4.pdf.
- Technical Guidelines for Environmental Dredging of Contaminated Sediments. Palermo et al. September 2008. U.S. Army Corps of Engineers. http://www.epa.gov/superfund/health/conmedia/sediment/pdfs/dredging_guidance.pdf.

Additional site-specific information is found at the following websites:

- Hudson River Dredging Resuspension Performance Standards: <http://www.hudsondredgingdata.com/Monitoring/Water>
- Case Studies of Environmental Dredging Projects (2003): <http://www.epa.gov/hudson/P40002.pdf>

Other site experiences or activities:

- Hudson River: There were problems with resuspension during the 2009 Phase 1 dredging, so EPA set up a peer review panel and issued more stringent standards for Phase 2.² During Phase 2 dredging operations, an extensive water monitoring program measures water quality and the amount of dredged sediment that is being resuspended and transported downriver. During Phase 2, the 500 parts per trillion federal standard for PCBs under the Safe Drinking Water Act has not been exceeded, as measured at Waterford, New York, the farthest downstream monitoring location in the upper Hudson River.³

² EPA Hudson River Dredging Data Website. <http://www.hudsondredgingdata.com/Monitoring/WaterPhase1> and <http://www.hudsondredgingdata.com/Report>.

³ EPA News Releases from Region 2, November 5, 2013.

<http://yosemite.epa.gov/opa/admpress.nsf/d10ed0d99d826b068525735900400c2a/3cb340e41618367f85257c1a00619f13!OpenDocument>.

Economic Impacts

- *Is it possible do a simple assessment of economic benefits from the cleanup in terms of possible employment based on similar scale projects – types of jobs, numbers of jobs, other types of indirect economic benefits like local procurement?*
- *Is it possible to do some basic research on best practices to maximize the economic benefits over the course of the project?*
- *What are the likely negative economic impacts during construction from river closures, traffic impacts, etc. (also see below mitigation measures)?*

TASC Response:

TASC's research on economic impacts is presented in a separate report.

Disruption During Construction and After Capping

Another major area of discussion is the level of impact from the construction on traffic and boating.

- *Is there any way to provide an overview of likely disruptions given similar experiences and identify the strategies for minimizing the negative side effects like those that impact traffic, bridges, boating?*

TASC Response:

The Focused Feasibility Study describes likely disruptions during construction of the remedy. These include temporary noise, light, odors, blocked views, potential air quality impacts and disruptions to commercial and recreational river users (operating for a few months at a given location). These impacts could be lessened through use of best management practices documented in community health and safety plans, but disruptions may still be significant, since dredging and backfilling or capping is expected to proceed 24 hours a day, six days per week and 40 weeks per year. Community members may want to request that EPA develop Quality of Life Performance Standards, such as those implemented at the Hudson River site. For that project, performance standards were specified for polychlorinated biphenyls (PCBs) in air, odors, noise, lighting and river navigation.⁴

Proposed Passaic Project

Bridge Openings: Opening of bridges along the Lower Passaic River during dredging and capping will temporarily impede road and train traffic crossing the bridges. There are 14 active bridges and one inactive bridge in the study area. Bridges are expected to be open from 15 to 30 minutes each time a barge passes through. More information about issues that arose with bridges during the dredging of RM10.9 of the Lower Passaic River is included at the end of this report, in Appendix A. The Cooperating Parties Group (CPG) published bridge schedules during the dredging of RM10.9. One such schedule is included in Appendix A of this TASC report.

Truck Traffic: The FFS says that the large volume of truck traffic associated with disposal of dredged material in an upland disposal facility would add to congestion on area roads and could damage roadways if dredged material management (DMM) Scenario C were chosen. For the preferred alternative, DMM Scenario B, only coarse material separation and dewatering would be performed at the upland processing facility. Then, materials would be loaded onto rail cars and shipped off site. It is unclear from the preferred plan if there would

⁴ EPA Hudson River Dredging Data Website. <http://www.hudsondredgingdata.com/Home/EPA>, see left sidebar for links to monitoring results for air quality, odor, noise, lighting and navigation.

be increased truck traffic associated with bringing in clean material for capping dredged areas in the river, or if transport of these materials can be handled mostly by rail and barge.

Hudson River Project

Before the Hudson River dredging project began, EPA investigated the potential impacts of the selected remedy, including air quality, odor, noise, road traffic, river traffic and socioeconomic impacts. These investigations were documented in a series of “white papers” included in the 2002 Record of Decision’s responsiveness summary.⁵

Quality of Life: A news article reported that 54 “quality of life” complaints were received in 2013, mostly involving noise. There were two documented cases where crews exceeded noise limits at night. Several complaints were also about the wake created by boat traffic.⁶

Truck Traffic: “A new, two-mile road parallel to the Champlain Canal was built by GE to reach the site. The use of this road reduced the volume of project-related traffic moving through local neighborhoods.”⁷

- *What is the likely level of curtailment of boat traffic during construction? Will entire sections be blocked or just one side at a time, again based on how this has been handled elsewhere?*

TASC Response:

The FFS indicates that adverse effects on commercial and recreational use of the river will be minimized to the extent possible. “Work areas in the river would be isolated (access-restricted) with an adequate buffer zone so that pleasure craft and commercial shipping can safely avoid such areas. Increased in-river barge traffic would be monitored and controlled to minimize, to the extent possible, adverse effects on the commercial or recreational use of the Lower Passaic River” (pages 5-23 and 5-38).

Other Projects:

The Hudson River cleanup is in its fifth season of dredging. The webpage for boaters, <http://www.hudsondredging.com/for-boaters>, indicates that boating activities are allowed to continue on the river, but extra caution is needed. The website says, “Boaters traveling in areas where the work is being performed should take care to avoid work areas, which will be marked by buoys. Boaters traveling through work areas **are asked to contact the project’s vessel traffic center on VHF Channel 18A for information**, as work areas change daily.” The webpage also provides a link to additional information for boaters.⁸

The Fox River cleanup is in its sixth season of dredging. The webpage for boaters, <http://foxrivercleanup.com/attention-boaters-anglers>, indicates that boating activities are allowed to continue on the river, but extra caution is needed.

⁵ EPA and U.S. Army Corps of Engineers. Responsiveness Summary, Hudson River PCBs Site Record of Decision. January 2002. http://www.epa.gov/hudson/d_rod.htm#response.

⁶ Post, P. \$1B Hudson River dredging to take three more years to complete. Saratogian News. December 5, 2013. <http://www.saratogian.com/environment-and-nature/20131205/1b-hudson-river-dredging-to-take-three-more-years-to-complete>.

⁷ GE. Hudson River Project Report, December 27, 2013. <http://www.hudsondredging.com/wp-content/uploads/2013/12/HudsonRiverProjectReport.pdf>.

⁸ http://www.hudsondredging.com/wp-content/uploads/2013/10/GE_DRG_lockhandout_1013.pdf

- *How realistic is the four-year timeframe given production rates on similar projects?*

TASC Response:

The FFS states that for EPA's preferred alternative, "in-river construction is estimated to take 4.5 years, starting in 2018 and ending in 2023 with an additional 6 months to complete dredged material processing."

The FFS assumes a dredging production rate of 2,000 cubic yards per day per dredge (Appendix F, pages 2-9 to 2-10). This assumed rate is based on the 2005 Environmental Dredging Pilot Study, in which an environmental dredge equipped with a clamshell bucket dredged about 4,150 cubic yards over a five-day period (830 cubic yards per 8.3-hour workday).⁹ Converting to a 24-hour workday yields a dredging rate of 2,200 to 2,500 cubic yards per day (page 9-4). EPA assumes a dredging season of 40 weeks per year, with operations conducted 24 hours per day, six days per week during the season (240 days per year). The FFS describes using two dredges, either mechanical or hydraulic.

The timeframe appears fairly dependent on issues that may arise throughout the project. These include:

- The accuracy of the estimated amount of material to be dredged.
- Issues with bridges (during the dredging at RM10.9, delays occurred due to bridges being closed for repairs).
- Any litigation that may arise could cause delays.
- Unanticipated complications (e.g., types of sediment, identification of shipwrecks, weather, resuspension, need for silt curtains or sheetpiling).
- Ease of project can potentially shorten the timeframe.

It is difficult to compare this site with other dredging projects because of the many variables. These include project-specific differences (e.g., location, current, types of sediment, number of impediments) and dredge differences (i.e., hydraulic vs. mechanical dredges).

Fox River Superfund Site: For the 2014 season, EPA plans to use three 8-inch hydraulic dredges and a 12-inch hydraulic dredge working 24 hours per day, five days per week from early April through early November, removing an estimated 20,000 cubic yards of sediment each week.¹⁰ This equals 1,000 cubic yards per dredge per day.

Hudson River PCBs Superfund Site: Using the information below, the dredging rate at the Hudson River began at about 2,200 cubic yards per day during Phase 1, and has reached about 5,000 cubic yards per day in 2012. This is the total rate for the site (not per dredge). The Hudson River project uses mechanical dredges. Phase 1 used about 10 dredges; Phase 2 reduced the number of dredges to about 2.5.¹¹

⁹ EPA, USACE, NJDOT. Environmental Dredging Pilot Study, p. 9-3, <http://www.ourpassaic.org/Dredging.aspx>.

¹⁰ EPA. Fox River Current, Spring/Summer 2014. <http://www.epa.gov/region5/cleanup/foxriver/current/foxcurrent201406.pdf>.

¹¹ Appendix II-I Hudson River PCBs Site EPA Phase 1 Evaluation Report March 2010.

<http://www.hudsondredgingdata.com/documents/pdf/Appendices/Appendix%20II/Appendix%20II-1%20July%2015,%202009%20RPS%20Exceedance%20of%207-Day%20Runnin%20Ave%20Control%20Level%20Memo.pdf>.

International Dredging Review. GE Reports Elevated PCBs in Hudson River. July-August 2009. <http://www.dredgemag.com/July-August-2009/GE-Reports-Elevated-PCBs-in-Hudson-River>.

GE. Hudson River Dredging Project Phase 2: Year 1. CAG Meeting Presentation. September 22, 2011. http://www.hudsoncag.ene.com/files/GE%20Project%20Update_09222011.pdf.

Phase 1: Removal of 283,000 cubic yards from May to October 2009 (six months).

Phase 2: Removal of 2.4 million cubic yards. Estimated duration of five to seven years, with dredging taking place from May to October.¹² Began in 2011. Annual dredging goal of 350,000 cubic yards.

2013 Update: Started in 2009. Annual dredging goal of 350,000 cubic yards exceeded in 2013 (612,000 cubic yards) and 2012 (more than 650,000 cubic yards). Dredging completion expected in 2015.¹³

- *What are the identified restrictions to boating in the FFS and Proposed Plan and are these in line with other sites? Are there other boating impacts that could occur which are not articulated?*

TASC Response:

The FFS indicates that restrictions to boating are likely to be vessel speed reductions, depth of draft limitations, prohibitions on anchoring within the FFS Study Area and recreational boating restrictions in shoal areas to protect the engineered cap.

Information about boating restrictions at other sites is covered under the boating question above.

Duration and Maintenance of the Cap

- *Can the cap be expected to last in perpetuity for a tidal river?*

TASC Response:

Underwater capping of contaminated sediments has been used at many sites over the past several decades, and has become an accepted cleanup method.¹⁴ The design of underwater caps has become a highly sophisticated area of engineering. Caps can be successful in tidal water bodies; tidal effects should be taken into account when designing the cap. Palermo and Reible (2007) recommend that an erosion analysis should evaluate a 100-year flow event, a 100-year wind event and the propeller wash from an appropriate type of ship (p. 325). EPA's FFS for the Passaic River's lower eight miles evaluated a 100-year storm and a 500-year storm (Appendix B-I). The FFS states that the potential for erosion from prop wash should be evaluated during the remedial design (p. 4-9). Although the FFS did not evaluate in detail the potential for erosion from wind and prop wash, EPA does not expect that these will be major problems:

It is important to note that boat wake and wind-induced waves were not considered in this analysis. With respect to boat wakes, Dr. Craig Jones (personal communication) suggested that boat wake or

¹² EPA. Hudson River PCBs Superfund Site, Cleanup Plans and Documents. <http://www.epa.gov/hudson/plans.html>.

¹³ EPA. News Release from Region 2. November 5, 2013.

<http://yosemite.epa.gov/opa/admpress.nsf/d10ed0d99d826b068525735900400c2a/3cb340e41618367f85257c1a00619f13!OpenDocument>.

¹⁴ EPA. Guidance for In-Situ Subaqueous Capping of Contaminated Sediments. 1998.

<http://www.epa.gov/greatlakes/sediment/iscmain>.

EPA. CLU-IN Site for Sediment Capping. <http://www.clu-in.org/contaminantfocus/default.focus/sec/Sediments/cat/Remediation/p/1>.

Palermo, M. and D. Reible. The Evolution of Subaqueous Cap Design. 2007.

https://www.google.com/url?sa=t&rct=j&q=&esrc=s&source=web&cd=1&cad=rja&uact=8&ved=0CB8QFjAA&url=https%3A%2F%2Fwesternredredging.org%2Findex.php%2Fwoda-conference-presentations%2Fcategory%2F56-session-2d-sediment-management%3Fdownload%3D218%3A3-palermo-the-evolution-of-subaqueous-cap-designpdf&ei=dS60U66hH8eZqAb5goCABw&usq=AFOjCNH-pshSs3_fTUV2JPL_YwRhZgqonO&bvm=bv.70138588.d.b2k;

Reible, D. In Situ Sediment Remediation Through Capping: Status and Research Needs. 2004. <http://www.clu-in.net/download/contaminantfocus/sediments/reible-capping-2004.pdf>.

propeller wash effects would largely act to “mix” the capping material locally, since it would be unlikely that a boat (or boats) would follow the exact same path within the river time after time. With respect to wind-induced waves, due to the narrowness of the river and due to the meandering nature of the river it is unlikely that significant wind-waves could develop. (App. B-I, p. 5-7)

The FFS also states that “cap erosion due to ice jams are not considered a major concern in the FFS Study Area but should be evaluated more thoroughly during the remedial design” (p. 4-9).

The FFS states that shallow areas near the river’s banks would be more prone to erosion from wind-waves than would be deeper areas, but that “armoring techniques or selection of erosion resistant capping materials make capping technically feasible in higher energy environments” (p. 4-10). However, EPA’s conceptual design for the proposed cleanup shows that armoring is proposed mainly for the outside of the river’s bends, where the depth is greater (FFS Figure 4-6). Community members may want to ask EPA what specific measures may be taken in shallow areas to prevent erosion from wind-waves.

The cap would not be expected to last in perpetuity without monitoring and maintenance. The FFS states that, “as part of the post-construction monitoring program, the thickness of the engineered cap would be monitored and maintained in perpetuity following implementation” (FFS, page ES-10). The FFS states that modeling of potential cap erosion showed that sand meeting NJDOT specification I-7 would remain stable under normal flow conditions (page 4-6). Modeling also identified areas that would be more susceptible to erosion and would require armoring of the cap.

- *What are the realistic long-term maintenance requirements of the cap?*

TASC Response:

Long-term maintenance of the cap is expected, including replacing cap materials periodically. EPA assumes the following monitoring and maintenance activities (FFS, Appendix H):

- Biological monitoring conducted monthly
- Annual monitoring
 - Bathymetric survey
 - Water column sampling
 - Sediment sampling
 - Habitat recolonization
 - Ice scour evaluation
- Annual maintenance
 - Cap maintenance performed on an as-needed basis
 - EPA assumes 0.2 percent of cap material will be replaced annually
 - No maintenance is expected for areas where backfill and armor are used
- EPA assumes that additional maintenance will be needed every five years
 - Five percent of the cap material will be replaced
 - Replant 10 percent of natural shoreline

The cap composition and thickness would be designed to isolate remaining contaminants from the water column. Details of the analysis to determine cap thickness are provided in Appendix F of the FFS. The design of the cap will account for expected consolidation, effects of animals and plants, and erosion of the cap materials.

EPA's Proposed Plan states that the post-construction monitoring period will last 30 years (page 40). EPA's "Guide to Developing and Documenting Cost Estimates During the Feasibility Study" states that:

Past USEPA guidance recommended the general use of a 30-year period of analysis for estimating present value costs of remedial alternatives during the FS (USEPA 1988). While this may be appropriate in some circumstances, and is a commonly made simplifying assumption, the blanket use of a 30-year period of analysis is not recommended. Site-specific justification should be provided for the period of analysis selected, especially when the project duration (i.e., time required for design, construction, O&M [operation and maintenance], and closeout) exceeds the selected period of analysis. For long-term projects (e.g., project duration exceeding 30 years), it is recommended that the present value analysis include a "no discounting" scenario. (page 4-2)¹⁵

Community members may want to ask how EPA will ensure that the cap's monitoring and maintenance continue forever, as opposed to the 30-year monitoring period assumed in the FFS. Community members may also want to request that EPA calculate a cost estimate for the proposed cleanup that uses a monitoring and maintenance period much longer than 30 years, as well as a "no discounting" scenario, to more accurately reflect the length of time that monitoring and maintenance will be needed. Such a cost estimate would allow a more accurate comparison with the site's other cleanup options.

- *What will be necessary for long-term coordination with local governments, boat clubs, etc., to make sure people have the information they need to plan for new activities over time?*

TASC Response:

The FFS Appendix H cost estimates describe annual O&M activities, including community outreach. Community outreach includes public meetings, fact sheet development, maintenance of the administrative record and other efforts to communicate with the public on the status of work and conditions in the FFS Study Area. In the long term, the public will have the opportunity to review and comment on the required five-year reviews, which will explain the status of the remedy.

TASC suggests community members provide feedback on local best methods for future communications such as social media, websites, advertisements, public meetings and fact sheets.

¹⁵ EPA. A Guide to Developing and Documenting Cost Estimates During the Feasibility Study. July 2000.
<http://www.epa.gov/superfund/policy/remedy/pdfs/finaldoc.pdf>.

Appendix A:

Bridge Opening Schedule and Issues Noted for Dredging of River Mile 10.9 in Lyndhurst

The Lower Passaic River Study Area Cooperating Parties Group (CPG), under the supervision of EPA, published bridge opening schedules during the dredging of River Mile 10.9 (RM10.9) of the Lower Passaic River. Table A-1 is the schedule for the week of August 22-29, 2013. Bridge openings typically took place at night to minimize impacts and opening/closing of bridges took between 15 to 30 minutes.

The CPG website for the project (www.rm109.com) also notes that some bridges across the Lower Passaic River were closed for repairs at different times during the dredging and capping. Closed bridges affected barge movement of dredged material and slowed the project. Information from weekly CPG project reports are shown below.

June 2013 – Bridge Street Bridge running between Newark and Harrison at RM 5.5 was not operational and had to be returned to service before the project could begin. The delay was about 1 month in duration.

August 3, 2013 – An Amtrak bridge was taken out of service over the weekend for repairs.

August 5, 2013 – The bridge opening scheduled for the night of August 5 is cancelled because of Amtrak bridge repairs.

August 8, 2013 – CPG informed that Bridge Street Bridge would be closed August 13-15 for repairs.

August 31, 2013 – Bridge Street Bridge became inoperable due to a mechanical failure. About 7,800 cubic yards of material had been dredged at that time. The bridge opening schedule resumed on September 18, 2013.

October 3, 2013 – Dredging was completed. More than 16,000 cubic yards of contaminated sediment was removed from the river bottom.

November 7, 2013 – Capping operations began. Barges carrying capping material would move up and down the river on a daily basis.

March 10, 2014 – CPG reported that during the months of March and April, the CPG would continue to use barges to transport armoring stone and sand to the project site. Barges were expected to move on the River during high tide two to three times per week.

The United States Army Corps of Engineers (USACE) lists the bridges of the Lower Passaic River in its Lower Passaic River Commercial Navigation Analysis, revised in July 2010 (see Table A-2 below).

Table A-1. Bridge Opening Schedule for August 22 – 29, 2013

Estimated Barge Movement Schedule on Passaic River, 8/22/2013 – 8/29/2013 (revised 8/22/2013)														
Date, Day and Direction of Barge Movements			Passaic River (The bridges listed here will be opened for anywhere from 15 to 30 minutes to allow barges to pass around the times listed below)											Hackensack River
Date(s)	Day(s)	Direction	RM 10.9	DeJessa	Rt. 7	Clay St.	Morristown RR	Bridge St.	Penn RR-Center	Penn RR-Market	Amtrak Dock	Jackson St.	Point-No-Point	RR at Howell Street Bridge
Located at River Mile:			10.9	10.37	8.53	5.83	5.57	5.41	4.75	4.75	4.75	4.37	2.33	3.1
8/22/13	Thursday PM-Friday AM	Upriver	10:45 PM	10:45 PM	10:15 PM	9:45 PM	9:40 PM	9:35 PM	9:25 PM	9:25 PM	9:25 PM	9:20 PM	8:50 PM	8:00 PM
8/23/13	Friday PM-Saturday AM	Downriver	8:30 PM	8:30 PM	9:00 PM	9:30 PM	9:35 PM	9:40 PM	9:50 PM	9:50 PM	9:50 PM	9:55 PM	10:25 PM	11:15 PM
8/24/13	Saturday PM-Sunday AM	Upriver	11:45 PM	11:45 PM	11:15 PM	10:45 PM	10:40 PM	10:35 PM	10:25 PM	10:25 PM	10:25 PM	10:20 PM	9:50 PM	9:00 PM
8/25/13	Sunday													
8/26/13	Monday PM-Tuesday AM	Downriver	11:00 PM	11:00 PM	11:30 PM	12:00 AM	12:05 AM	12:10 AM	12:20 AM	12:20 AM	12:20 AM	12:25 AM	12:55 AM	1:45 AM
8/27/13	Tuesday PM-Wednesday AM	Upriver	2:35 AM	2:35 AM	2:05 AM	1:35 AM	1:30 AM	1:25 AM	1:15 AM	1:15 AM	1:15 AM	1:10 AM	12:40 AM	11:50 PM
8/28/13	Wednesday													
8/29/13	Thursday AM	Downriver	12:30 AM	12:30 AM	1:00 AM	1:30 AM	1:35 AM	1:40 AM	1:50 AM	1:50 AM	1:50 AM	1:55 AM	2:25 AM	3:15 AM

Schedule Assumptions

Train bridge openings are not delayed due to long train line crossings. Weather is conducive to travel.

Bridge openings are executed with no long-term delays requiring repairs. Tides and currents are normal.

Bridges are manned and opened prior to tug/scow arrival.

Table A-2. Bridges on the Lower Passaic River¹⁶

Bridge Name	River Mile	Bridge Type	Maximum Horizontal Clearance	Maximum Vertical Clearance [Low Tide]
<i>Point-No-Point Reach</i>				
Central Railroad of NJ (not in use)	1.2	Lift	145	NA
Lincoln Highway Bridge	1.85	Lift	300	45 (140) *
Pulaski Skyway	2.0	Fixed	520	140
<i>Harrison Reach</i>				
Point-No-Point Conrail	2.6	Swing	103	21
NJ Turnpike Bridge	2.7	Fixed	352	105
<i>Newark Reach</i>				
Jackson Street Bridge	4.6	Swing	72	20
Amtrak Dock Bridge	5.0	Lift	200	29 (143)
Penn RR at Market Street	5.0	Draw	75	21
Penn RR at Center Street	5.0	Draw	80	10
Bridge Street Bridge	5.7	Swing	80	12
Morristown Line RR Bridge	5.85	Swing	77	20
Stickel Bridge	5.9	Lift	200	40 (140)
<i>Kearny Reach</i>				
Clay Street Bridge	6.1	Swing	75	13
Fourth Ave Conrail Bridge	6.35	Bascule	126	12
<i>Arlington Reach</i>				
Erie/Montclair-Greenwood Lake RR Bridge	8.1	Swing	48	40
* Vertical clearance in parentheses refers to clearance when the lift bridge is open.				

NA: Not Applicable since bridge removed.

¹⁶ United States Army Corps of Engineers. Lower Passaic River Commercial Navigation Analysis. Revised July 2010.